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Los Alamos
National Laboratory

Environment, Safety, and Health Division

Air Quality Group
(ESH-17)

Sampling and Analysis Plan

for the

Radiological Air Sampling Network (AIRNET)

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Approved by: Doug Stavert, ESH-17 Group Leader	Date: 8/16/00

02/03/04

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Appendices

This plan has the following appendices:

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Distribution List (A3)

List of document recipients

This document will be controlled under the organization's document control system (ESH-17-030, "Document Distribution") to ensure that those performing work for the system will receive a controlled copy and all revisions. Those who will receive or have nearby access to a controlled copy include:

- ESH-17 Group Leader
- ESH-17 QA Officer
- ESH-17 Rad-NESHAP Project Leader
- ESH-17 Air Monitoring Project Leader
- ESH-17 Area G Project Leader
- ESH-17 Consent Decree Project Leader
- ESH-17 AIRNET system staff members
- ESH-17 AIRNET system technicians
- Assistant Area Manager, Office of Environment and Projects, DOE Los Alamos Area Office

Introduction

History of revision

This table lists the revision history of this plan.

Revision	Date	Description Of Changes
0	---	Revision number not used.
1	5/8/87	New document.
2	1/10/90	Revisions to reflect changes in program.
3	12/21/95	Extensively revised following QA/R-5 format to meet new requirements in the FFCA and 40 CFR Part 61.
4	10/2/96	Changes to reflect new stations, analytical methods, and group project management.
5	7/7/97	Changes to analytical methods for alpha and beta counts; updated location list and station grouping; added consent decree requirements; editorial changes throughout.
6	1/4/99	Revised into Sampling and Analysis Plan format, parts moved to appropriate project plans.
7	6/23/00	Updated titles, sampler siting criteria, and other details.

Purpose of this plan

This sampling and analysis plan describes the processes that are common to the projects that utilize data from the AIRNET system. Those projects include the Rad-NESHAP, Environmental Surveillance Report, Area G, and Consent Decree projects.

Structure of the quality program

The project plans that reference this document are the second-tier documents to the ESH-17 Quality Management Plan (ESH-17-QMP). The following documents ensure that the AIRNET system is operated in accordance with the requirements in the applicable QA project plan:

- ESH-17 Quality Management Plan
- QA Project Plan for either Rad-NESHAP, Area G, or Consent Decree, in combination with the AIRNET Sampling and Analysis Plan (this document)
- QA Project Plan for the Meteorology Monitoring Project
- implementing procedures

Revising this plan

This plan will be controlled through the ESH-17 document control program (ESH-17-030, “Document Distribution”). The project leaders, at least one reviewer, and the group leader will approve all revisions to this plan.

Organization (A4)

Group organization

The Air Quality Group (ESH-17) of the Environment, Safety, and Health (ESH) Division is responsible for the AIRNET system at Los Alamos National Laboratory (LANL). See the Group ESH-17 Quality Management Plan (ESH-17-QMP) for a description of the group organization, level of authorities, and lines of communication. The group is organized by project teams under the line management direction of the group leader. Project teams are cross-functional and focus on specific LANL air quality responsibilities, deliverables, or products. Project teams are guided by team leaders who have the responsibility to assure the project is completed.

Project organization

The ESH-17 Rad-NESHAP Project Leader, the Air Monitoring Project Leader, the Consent Decree Project Leader, and the Area G Project Leader manage the operation of the AIRNET. These project leaders report to the ESH-17 Group Leader. A group QA specialist is assigned to work for the project leaders to provide quality assurance assistance, advice, and review. The Meteorology Monitoring Project Leader provides some meteorological data parameters. The group analytical chemist provides support to the project leader in interfacing with analytical laboratories, uploads electronic data deliverables, and reviews chemistry data packages. Other group members work for the project leaders to collect samples, process collected samples, maintain samplers, manage databases, and provide dose assessment and data evaluation. In addition, representatives from other groups may participate and contribute to this team. The organization within each project is shown in the appropriate project plan.

Other supporting organizations

Other groups in LANL and subcontracting organizations provide support to ESH-17 for the AIRNET.

Wastren-Grand Junction of Grand Junction, Colorado, and Paragon Laboratories of Fort Collins, CO, currently provide analytical services for the air filters and the silica gel, respectively. In the future, other or additional laboratories or organizations may be contracted to provide analytical support. Subcontract analytical laboratories report to and are responsible to the ESH-17 analytical chemist.

Organization (A4), continued

Approval of final products and deliverables

Final products and deliverables resulting from the AIRNET, listed below, will be approved by the indicated personnel:

NOTE: The calculation and reporting of doses from the air concentrations are described in the respective project plan.

Product	Approvers
Biweekly air concentrations	AIR MONITORING Project Leader Rad-NESHAP Project Leader Area G Project Leader (as applicable) Consent Decree Project Leader (as applicable)
Quarterly air concentrations	Air Monitoring Project Leader Rad-NESHAP Project Leader Area G Project Leader (as applicable) Consent Decree Project Leader (as applicable)

Problem Definition and Background (A5)

Problem definition

A system is needed to:

- determine the environmental impact of Laboratory radioactive air emissions, according to requirements found in DOE Order 5400.1 and guidance in DOE/EH-0173T; and

- determine the off-site dose contribution from non-point source Laboratory radioactive air emissions, according to the requirements of 40 CFR Part 61.94(b)(5) as outlined in the Appendix A Compliance Plan of the Federal Facilities Compliance Agreement (FFCA) between the Department of Energy (DOE) and Environmental Protection Agency (EPA).

[The AIRNET system does **not** measure the short-lived gaseous activated air product emissions produced by LACEF (Los Alamos Critical Experiment Facility) at TA-18 nor the Los Alamos Neutron Science Center (LANSCE, formerly known as the Los Alamos Meson Physics Facility). Calculation of emissions from TA-18 is described in procedure ESH-17-506, and measurement of LANSCE emissions is described within the “QA Project Plan for the Rad-NESHAP Compliance Project,” ESH-17-RN.]

System Description (A6)

Purpose of the system

The radiological air sampling network (AIRNET) at Los Alamos National Laboratory is designed to continuously sample environmental levels of airborne particulate radionuclides and tritium emitted from all LANL operations and sites (as required by the FFCA and the DOE Orders 5400.1 and 5400.5). The method relies on the collection and measurement of airborne particles and tritium oxide at locations around the Laboratory, including the location of the maximally exposed individual (MEI), and the calculation of the dose from those measurements.

Applicable regulatory quality criteria

Applicable quality criteria include 40 CFR Part 61, Appendix B, Method 114, Section 4; DOE Order 5400.1 (“General Radiation Protection Program”); DOE Order 5700.6C (“Quality Assurance”); and the LANL “Quality Assurance Management Plan” (PRD-110-01).

The group chose to write this plan in accordance with the EPA standard for quality plans (EPA QA/R-5, “EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations”). However, many items of this standard are located in the respective project plan documents.

Measurements to be made

Continuous sampling of the air will be performed to determine the concentration of radionuclides in the air. Analytes will be chosen based on whether they are emitted or have the potential to be emitted at a level sufficient to contribute over 1 mrem dose to the MEI and whether they may contribute to environmental contamination [see the section *Quality Objectives and Criteria for Measurement Data (A7)*, page 11]. AIRNET sample media will be analyzed for uranium (^{234}U, ^{235}U, ^{238}U), plutonium (^{238}Pu, $^{239/240}$Pu), americium (^{241}Am), and tritium (^{3}H, as oxide). Analyses for other specific radionuclides can be performed for an unplanned release or other emergency situation, or if Laboratory operations warrant (e.g., to identify any contribution from a new potential source).

In addition, gross alpha, gross beta, and gamma spectroscopy counts will be performed shortly after filter collection in order to detect unexpected quantities of radionuclide releases and allow determination of any adverse trends in the ambient concentration of radionuclides.

System Description (A6), continued

Change in gamma spectroscopy

Gamma analyses of each AIRNET filter have been conducted for many years. However, the quality of those data was often variable. In 1996, a program was instituted where biweekly filters from individual stations were clumped together (FFCA stations, on-site stations, regional stations, etc.). In addition, the filters were counted within 2 weeks of collection, thus improving the ability to measure radionuclides with short half-lives. In the fall of 1997, gamma data were evaluated (ESH-17:97-499, ESH-17:97-524, ESH-17:97-561) and the results demonstrated that 1) detection limits specified later in this plan could be met and 2) the analytical laboratory analyses are now consistent and valid.

Starting in 1998, gamma spectroscopy was performed on quarterly composites by station for compliance and Area G samples as a long-term check on the clump results.

System Description (A6), continued

Special equipment requirements

The AIRNET will rely upon continuously operating vacuum pumps that pull known rates of air through a collection filter and silica gel.

The sample analysis laboratory must have equipment for analyzing very low levels of radioactive elements by the following methods:

- direct alpha counting (to determine the gross alpha decay activity)
- direct beta counting (to determine the gross beta decay activity)
- gamma spectroscopy (for detecting radionuclides that decay by gamma-ray emission)
- liquid scintillation counting (for detecting beta decays from tritium)
- alpha spectroscopy (for detecting low levels of uranium, plutonium, and americium isotopes)

Assessments and reviews

Regularly scheduled system audits and management assessments will be performed in accordance with requirements from each project that uses AIRNET data. Analytical laboratories participate in interlaboratory comparison programs. These assessment tools are discussed in the section *Assessments and Response Actions (C1)*, page 45.

Schedule for the monitoring

The sampling will be performed on a continuous and on-going basis. This will allow collection of appropriate data for dose assessment and the determination of any unplanned release.

Required records and reports

Records kept will provide a trail, which can be audited, of the operation of AIRNET. Appropriate and sufficient records will be maintained for a minimum of 200 years (as specified by DOE requirements which exceed the 5-year requirements in 40 CFR Part 61.95) so the results can be verified or recalculated later. Such records will include, but are not limited to, documentation of field and laboratory equipment calibration, sample collection, sample analysis, and dose calculation and interpretation. See the section *Documentation and Records (A10)*, page 17, for a more specific list of the records to be preserved.

Reports of the calculated dose will be produced [see the section *Reports to Management (C2)*, page 47].

Quality Objectives and Criteria for Measurement Data (A7)

What are DQOs?

Data quality objectives (DQOs) are statements of the uncertainty level a decision-maker is willing to accept in results derived from environmental data. DQOs must strike a balance between time, money, and data quality.

The major elements of the DQOs for the AIRNET system are presented in the respective project quality plan that references this document. The following elements of DQOs are common to all the plans and are presented in this document.

Tolerable limits on decision errors

A false high measurement of radionuclides could limit LANL operations unnecessarily. A false low measurement of radionuclides might result in noncompliance with the 10-mrem dose standard.

The action levels chosen (see the respective quality project plan and ESH-17-201) are sufficiently low to ensure operation within regulatory limits (probability of a false negative, or a failure to detect an exceedance, is near zero), but are sufficiently high to minimize unnecessary responses and investigations (false positive responses are minimized).

Representa-tiveness

Representativeness is a measure of the degree to which the data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Air samplers will be operated continuously (as defined by the FFCA; see “Completeness” below) throughout the year; consequently, there is complete sampling of temporal variations. Air samplers will be located in or near sites occupied by the public, near actual or probable release points, and in background locations. These locations will be chosen to obtain samples representative of the concentrations they are intended to measure and will be evaluated against the siting criteria presented later in the section *Sampling Process Design (B1)*.

Comparability

Comparability is a measure of the confidence with which one data set can be compared to another.

Comparability of the sampler data is ensured because of the use of the same equipment, processes, and analytical methods at all sampler locations.

Quality Objectives and Criteria for Measurement Data (A7), continued

Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions.

Data may be lost due to equipment malfunction, power failure, sample destruction, human error, loss in shipping or analysis, analytical error, failure to collect an adequate volume of air during the sampling period, inability to gain access to the site, or unacceptable data uncertainty.

The samplers will be designed to achieve the performance objective of 95% run-time completeness for the 17 compliance samplers (as required by the Appendix A Compliance Plan, FFCA) and for stations 27, 30, 34, 36, 54, and 55 (as required by the Consent Decree between DOE and Concerned Citizens for Nuclear Safety); and 90% for all other samplers. This objective means that the time during which a sampler is not operating satisfactorily due to malfunctions (including components in the sampler housing that cause a sample to be unusable), filter or sampler changes, maintenance, calibration, and similar conditions will not exceed 5% or 10% (compliance/consent decree and other samplers, respectively) per calendar year. In addition, at least 80% of the total possible samples (during any calendar year) are required to provide valid data (see Appendix A Compliance Plan, FFCA).

Precision

Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed conditions, expressed generally in terms of the standard deviation. It refers to the variability that occurs if the same analysis were performed again on the same sample with no change in conditions, or the degree to which repeated measurements on the same sample agree. Results of repeated analyses of standard or duplicate samples provide an estimate of laboratory or instrument precision.

The regulation 40 CFR Part 61.93 requires that the system be able to readily detect a dose of 1.0 mrem above background. Following statistical principles and assuming a confidence of 95% on such a detection, 95% of all measurements must fall within two standard deviations of the mean measurement. If two standard deviations is 1.0 mrem, then 1 standard deviation is approximately 0.5 mrem. This represents the minimum acceptable precision for decision making.

Quality Objectives and Criteria for Measurement Data (A7), continued

However, to confidently detect environmental concentrations that are significantly less than 1.0 mrem, a smaller precision is needed. Therefore, the AIRNET will use 0.1 mrem as the target precision for all measurements. Restated, the measurement uncertainties for each radionuclide will be equivalent to a concentration matching the 0.5 mrem (minimum) or 0.1 mrem (target minimum) dose level.

Estimates of total uncertainty at 10 mrem concentrations are discussed later, but precision has been calculated from the two sets of paired AIRNET stations for environmental concentrations based on the difference in the results using 1996 and 1997 data. These precision estimates are calculated for tritium and isotopic analyses. The isotopic analyses were grouped together because the sample size was too small to evaluate each radionuclide individually. As shown in the following table, the uncertainty (standard deviation) of the measurement, expressed as a percent of the concentration, decreases with increasing concentration:

Precision estimates from paired AIRNET stations (data from 1996 and 1997)

Radionuclide	Concentration per sample	Millirem equivalent	Precision for an annual concentration (1 std. dev.)	Percent of annual concentration
Pu, U, and Am	100 aCi/m^3	0.5 (max)	11 aCi/m^3	11
Pu, U, and Am	500 aCi/m^3	2.6 (max)	35 aCi/m^3	7
Pu, U, and Am	1000 aCi/m^3	5.3 (max)	50 aCi/m^3	5
Tritium	10 pCi/m^3	0.07	0.38 pCi/m^3	3.8
Tritium	50 pCi/m^3	0.33	0.43 pCi/m^3	0.86
Tritium	100 pCi/m^3	0.67	0.71 pCi/m^3	0.71

Accuracy

Accuracy is the degree of agreement of a measured value with the true or expected value of the quantity of concern. It is not possible to determine the true accuracy of measurements determined by this project, but an estimate of overall uncertainty (accuracy plus precision) is presented in the subsection below.

Quality Objectives and Criteria for Measurement Data (A7), continued

Any bias (known inaccuracy) will be corrected for if it is known or estimated. Unknown bias will be presumed to be zero because this is the most likely value. To reduce bias, all measurements will be traceable to nationally recognized standards such as those provided by NIST.

Uncertainty analysis of AIRNET measurements

The Appendix A Compliance Agreement (FFCA) requires that the overall uncertainty of all measurements be no greater than 20% at the concentrations in 40 CFR 61, Appendix E, Table 2 (equivalent to an annual dose of 10 mrem).

To assess whether the AIRNET can attain the uncertainty (precision plus accuracy) required, an analysis was performed on the various sources of measurement uncertainty in the system. Uncertainties were calculated for quarterly composite ^{239}Pu and biweekly tritium measurements from AIRNET stations. ^{239}Pu was chosen for this analysis because of its more restrictive dose conversion factor (see memo ESH-17:95-759; the tritium uncertainty analysis in this memo is no longer applicable due to a change in the tritium calculation method). Tritium uncertainty was calculated because it is measured and analyzed using a different process. Uncertainties were estimated at air concentrations equivalent to 10 mrem/year. The sources, sizes, and totals of the uncertainties are presented in the table below.

Quality Objectives and Criteria for Measurement Data (A7), continued

Sources of Uncertainties of ^{239}Pu and ^{3}H Analyses (%)

Source of uncertainty	^{239}Pu*	^{3}H (oxide)
Counting statistics	1	2
Other analytical lab processes	10	5
Aliquoting	NA	0.2
Flow meter reading	10	NA
Flow meter calibration	5	NA
Timer	0.1	NA
Collection efficiency of filter	1	NA
Collection efficiency variation of silica gel	NA	10
Relative humidity	NA	5**
Temperature	NA	0.1**
Other	5	5
Propagated total	16	13

* Summarized from memo ESH-17:95-759.
** Calculated from instrument specifications and estimated 99th percentile worst-case meteorological conditions

Note that the uncertainty (%) for the counting of the sample will be significantly higher at the low concentrations normally found by AIRNET (due to the poorer counting statistics when counting low levels of activity).

Special Training Requirements and Certification (A9)

Required personnel education

See the project quality plans for any special personnel qualifications for the project. Personnel working for the AIRNET must understand the basics of radiation measurement and air sampling, and understand the general operation of the system. Individuals performing data review and interpretation must have additional education and/or experience as health physicists or radio-analytical chemists. Documentation of education qualification is maintained by the LANL personnel division.

Training of personnel

All personnel performing AIRNET-related work are required to obtain appropriate training prior to performing work governed by a procedure. Training for ESH-17 personnel will be performed and documented according to the ESH-17 procedures for training (ESH-17-024) and orienting new employees (ESH-17-032). Training of personnel in other groups will be performed and documented according to each group's training procedure.

Contractor analytical laboratories are required to have a quality management system in place that complies with the training requirements of DOE Order 5700.6C, Criterion 2.

Documentation and Records (A10)

Records resulting from the sampling and analysis system

The number, type, and detail of all records to be kept will provide sufficient information to allow an individual with equivalent education and training to verify or reconstruct the results. Implementing procedures specify the records, forms, logbook entries, or other information to be kept as documentation of the performance of the procedure.

Records to be kept in the ESH-17 records system (ESH-17-025, “Records Management”) include the following:

- logbook entries and/or field forms to record sample collection and chain of custody
- equipment and instrument calibration and maintenance records
- laboratory analytical results
- air concentration calculation results
- dose assessments and assumptions
- station siting evaluations
- general correspondence that affects the system
- regulatory correspondence

Records to be kept by the subcontractor laboratories include the following:

- equipment and instrument calibration and maintenance records
- laboratory quality control results
- laboratory instrument calibration and maintenance records

Subcontractor analytical laboratories retain and manage all documentation related to analyses. These records include statements of work, laboratory data, corrective action reports, logbooks, bench worksheets, training documents, etc.

ESH-17’s work scopes will request that data from the counting laboratory and analytical laboratory will be returned to the analytical chemist within 30 days (for biweekly samples) or 45 days (for quarterly composites) after sample submittal.

A field sampling and laboratory “case narrative” analysis of problems or special cases will not be required; instead, the deficiency procedure (ESH-17-026, “Deficiency Reporting and Correcting”) will be used to document quality-affecting problems encountered in the field and laboratory [see the section *Assessments and Response Actions (C1)*].

Documentation and Records (A10), continued

Reporting of final results

Final results for the time period in question will be presented as a simple summary of the resultant air concentrations (for the Environmental Surveillance Report) and a summary of concentrations converted to dose using the levels in 40 CFR Part 61, Appendix E, Table 2.

Records final disposition and retention period

All records will be maintained and available (after the deadline for submittal as given in applicable procedures) for auditing in the records center at the ESH-17 group office (ESH-17-025, "Records Management"). Records will be archived in compliance with Laboratory and DOE requirements for records retention, storage, and management. These requirements specify the protection of records from damage due to fire, flood, or rodents; monitored access to the records; and maintenance of the records for at least 5 years for inspection at the facility (as specified in 40 CFR Part 61.95) and up to 200 years (DOE/HQ DRAFT document, "DOE Records Schedule for Environmental Records," November 1996).

Sampling Process Design (B1)

Sampling system design

The primary design objective for the air sampling network for airborne radionuclides is to provide accurate measurements of radionuclide concentrations in nearby public use areas, around the Laboratory perimeter, on Laboratory sites, and in background locations. To achieve the objective, the system design is based on expected and potential airborne releases, with consideration given to normal operational controls and unplanned releases. The system can usually allow distinction between significant radioactive material released by the Laboratory and material that is naturally occurring or produced by non-Laboratory sources.

The specific media collected and the radionuclides measured are based upon the types of radioactive materials that may be released at the Laboratory. Strategically placed sampling stations monitor radionuclide concentrations in two general areas:

- in public occupancy areas
- between the point of maximum predicted concentrations and public use areas.

All air samplers are operated continuously. The samplers consist of a vacuum pump, flow metering valve, timer, and sample trains. The sample trains collect airborne particles and water vapor from the ambient air. These stations were designed to collect samples in the breathing zone (five to six feet [2 meters] above the ground).

Compliance sampler (MEI locations) design rationale

Locations for the compliance air samplers (listed in Appendix A, *AIRNET Sampler Locations*) were evaluated using a sampler network analysis. The primary consideration of this network analysis was the placement of samplers in all sectors that contain a potential MEI. Assumptions and criteria for this analysis included the following (see the Appendix A Compliance Plan, FFCA, for more detailed information on the analysis):

- A standard 16-sector radial array (22.5° sector angle) from potential release sites was used to evaluate potential MEIs.
- Maximum off-site concentrations for non-point source emissions will occur at the site boundary since all such emissions are considered ground-level or effective ground-level releases.
- All residence or business “islands” within the LANL boundary will be monitored.

Sampling Process Design (B1), continued

From this network analysis, 17 potential MEI locations were identified. All the sectors with a potential MEI will contain a sampler. These 17 locations will provide a sampler on or near the LANL boundary between or near the release point and the potential MEI for any given non-point source within LANL. This arrangement effectively provides a “wall” of samplers along the LANL boundary and all adjacent populated areas around or enclosed by LANL.

New compliance sampler locations

Since the analysis discussed above, three other potential MEI locations were identified:

<u>Los Alamos Ski Hill</u>:
The ski hill is several kilometers away from the LANL boundary, and is not in the prevailing wind direction. An analysis was performed using CAP-88 to determine if this location was in fact a potential MEI. The analysis demonstrated that the ski hill is not a potential MEI (memo ESH-17:00-133)

<u>East Park, the residential area immediately west of the Los Alamos Airport</u>:
A station location has been identified near the East Park residential area. The station will be installed after approval from Los Alamos County.

<u>The new research park, located immediately west of the fire station on West Jemez Road</u>:
The need for a station has been identified at the new research park and a station will be installed in this area.

See Appendix A (*AIRNET Sampler Locations*) for a list of all the sampling stations on the date of preparation of this plan.

Sampling Process Design (B1), continued

Future compliance station siting criteria

A special case for compliance monitoring siting was identified in the independent audit of the LANL Rad-NESHAP program (RAC, 1999). This special case occurs when there is a diffuse source of emissions (e.g., an environmental restoration project) located on the northern boundary of LANL directly adjacent to a business, office, or residence. In this case, the existing compliance criteria could require dozens of samplers to cover each wind direction sector containing a business, office, or residence.

New sources of diffuse emissions will be identified by reviewing the ESH IDs every month. If a new source is identified, it will be evaluated to determine if it could produce a dose equal to or greater than 0.1 mrem to a potential MEI in a wind direction sector from the source not covered by an existing compliance sampler. If this criterion is not met, one sampler will be placed in the downwind meteorological sector that could produce the highest dose. If an existing AIRNET sampler is within 100 m of this location, a new sampler will not be added. An addition to the existing monitoring criteria is being developed and will be submitted to EPA for their approval.

ESR station design rationale

The locations of stations used for environmental surveillance have been selected to meet the objective of DOE Order 5400.1, Environmental Protection Programs. The primary objectives include:

- Demonstrating compliance with public dose limits.
- Measuring accidental releases of radionuclides should they occur.
- Identifying and quantifying new or existing air quality problems.
- Characterizing trends resulting from air emissions.

Specifically, stations are located around the LANL site boundary in areas occupied by the public and downwind of Laboratory sources of radioactive air pollutants. Historically, stations have been grouped (see Appendix A, *AIRNET Sampler Locations*) as regional, perimeter, on-site, and environmental restoration, and waste site stations. These optional designations have been used for presenting information in the environmental surveillance report and for evaluating data against action levels.

Sampling Process Design (B1), continued

Background station design rationale

DOE suggests background stations be over 15 km from the site boundary. Regional background AIRNET samplers located in Española, El Rancho (less than 15 km from boundary but over 15 km from sources), and Santa Fe will be used to establish background concentrations for all radionuclides except the uranium isotopes. Natural background uranium levels at the regional background stations are actually *higher* than the uranium levels near LANL. If the regional values were used for background determinations, the reported MEI dose from LANL uranium operations would usually be *negative*. Therefore, for the special case of uranium background determinations, one of the AIRNET perimeter stations will be used as more representative of natural background uranium levels near LANL. The locations of these air samplers are identified in Appendix A (*AIRNET Sampler Locations*).

Other samplers design rationale

Other samplers have been located onsite to satisfy DOE requirements or to meet programmatic needs of a particular facility or program. The following considerations were used in siting the other AIRNET samplers:

- annual average wind speed and direction
- areas of on-site predicted maximum concentrations
- topographic and other features that could influence dispersion
- availability, safety, security, and accessibility of sampler locations
- availability of power
- customer’s specific programmatic needs for monitoring

Because of changing customer needs and budget priorities, the number and locations of these onsite samplers are subject to change. See Appendix A (*AIRNET Sampler Locations*) for a list and description of the sampling stations on the date of preparation of this plan. An up-to-date list of samplers is kept by the Air Monitoring Project Leader.

Sampling frequencies

A continuous sample of air will be collected during the sampling period. The samples will be collected from the air sampling stations approximately every two weeks. For the detection of unplanned releases as required by DOE, the guide DOE/EH-0173T recommends that the sampling interval not exceed two half-lives of the shortest-lived radionuclide being monitored (^{74}As with a half-life of 18 days). Samples may be collected at a shorter interval for emergency response or unplanned release situations.

Sampling Process Design (B1), continued

Sample matrices

Filter
Although atmospheric particle sizes range from about 0.01 to 10 microns (μm), the optimum size for deposition in the upper respiratory tract (and subsequently the deep lung) is 0.01 μm to 3 μm, with 1 μm often used for dose assessment (ANSI N13.1 Table). The filter paper should retain a minimum of 99% of dioctylphthalate (DOP) particles with an aerodynamic mean diameter of 0.3 μm, at the air face velocity and pressure drop expected in use (DOE/EH-0173T). The filter material must have a low uranium content to allow better determination of uranium background concentrations. Filter material will be obtained from an appropriate supplier. Web Dynamics grade 7301L air filtration media (polypropylene) has been used since approximately January 1996. Procedure ESH-17-202, "Environmental Sampling of Airborne Particulate Radionuclides," describes the steps to prepare filters.

Silica gel
Silica gel will be used to collect a sample of water vapor from the sampled air. As part of the water vapor, tritium in the form of either T_2O or HTO will also be absorbed. Water vapor concentrations are calculated from atmospheric temperature and relative humidity measurements. The silica gel will be obtained from a commercial supplier or the LANL stock supply system and will be discarded after use. The silica gel used is medium grade with an absorption capacity of 0.26 g of water per gram of gel at 50% relative humidity. Approximately 135 g of gel are used, giving a collection capacity of 35 g of water per collection period. Procedure ESH-17-204, "Sampling of Airborne Tritium," describes the steps to prepare the silica gel tubes.

Measurement parameters

Considering the actual and potential emissions of radionuclides at the Laboratory, the following parameters will be measured:

- sample collection time
- air flow rate through filter media
- atmospheric temperature and humidity
- gross alpha radiation on filters
- gross beta radiation on filters
- tritium concentration in water absorbed by the silica gel
- gamma-emitting nuclides on filters (optional)
- ^{238}Pu, $^{239/240}$Pu, ^{234}U, ^{235}U, ^{238}U, and ^{241}Am concentration on composited filters

Sampling Process Design (B1), continued

Sampler siting evaluation criteria

Each new proposed sampler site will be evaluated against the siting criteria (compiled from guidance documents DOE/EH-0173T and 40 CFR Part 58) according to ESH-17-207 ("Evaluation of AIRNET Sampler Sites Against Siting Criteria"). This procedure describes the application of the following criteria:

1. **Favorable surface characteristics:** To reduce the loading of filters by particles, ideal sites will have minimal extraneous material prone to air suspension in the immediate area.

2. **Trees acceptable:** According to guidance from 40 CFR Part 58, samplers "must be 10 m from the dripline when the tree(s) act as an obstruction."

3. **Distance to obstructions (primarily buildings) greater than two times the height of the sampler:** The distance between the sampler and the obstruction must be at least twice the height difference between the sampler and the obstruction (equivalent to a rise angle from the sampler to the top of the potential obstruction of approximately 27°).

4. **Unrestricted airflow in 270° arc containing source direction:** The object (excluding trees, which are addressed under criterion #2) must not fall within the 270° arc, relative to the sampler, that contains the specific source that is being monitored (40 CFR Part 58).

5. **Good topographic location:** The area surrounding a site should be as level and flat as possible.

Uniform application of these criteria is important to ensure consistency and adequacy among air sampler locations. Good scientific judgment will be used to select the optimal location based on site-specific criteria and on specific sampling needs. However, not all sites can meet all these criteria. An example is station #60 located in Los Alamos Canyon, up-canyon from TA-41 and TA-2. This station is intended to monitor the potential up-canyon dispersal of radioactivity from TA-41 and TA-2 to potential receptor locations at the Ice Skating Rink. The sampler must be located at the bottom of the canyon between the source area and the potential receptors. In the bottom of the canyon, the canyon walls are considered obstructions according to criterion #3, and there are extremely few locations where trees would be considered acceptable according to criterion #2. At this site, the specific need for the station outweighs the site-specific criteria and the sampler was sited to best provide the data required.

Sampling Process Design (B1), continued

Because at least a few sites are changed or moved slightly during a year, it would not be appropriate to keep an up-to-date list in this document. For this reason, the forms used to document the evaluations of sampler sites will be filed in the ESH-17 records system.

Field decontamination procedures and materials

No special field decontamination steps are required for the samples because of the low levels of activity, though every effort will be taken to avoid cross contamination and ensure that the levels are representative of environmental concentrations. Sampling procedures will specify the handling and packaging requirements to prevent cross-contamination and will include the following requirements:

- Filter heads will be dedicated for use at only one station to prevent potential cross-contamination.
- Filter heads will be cleaned of noticeable dirt and dust when disassembled.

Operational changes in the Cave (TA-54-1001, where samples are processed) will be reviewed prior to implementation. This will help prevent inadvertent sample contamination (e.g., changes in janitorial cleaning supplies that can contaminate tritium samples).

Analytical laboratories will be required to maintain appropriate controls for prevention of cross contamination.

Analysis frequency

Approximately every two weeks, samples will be collected and sent for the analyses described above in “Measurement parameters” and in the section *Analytical Methods Requirements (B4)*, page 33. Occasionally (e.g., over long holidays or Laboratory closures), samples may be collected after three weeks.

Sampling Methods Requirements (B2)

Air sampling equipment

Each standard model air sampler consists of a particulate filter assembly, a silica gel water vapor absorber, two flow metering units, and an oilless, constant flow vacuum pump, all enclosed in a lockable weathertight housing. Included in the housing assembly are various connecting and exhaust hoses and a 117 volt electrical supply circuit. All equipment will meet the following requirements:

<u>Vacuum Pump</u>
The air sampling pump must be capable of running continuously without overheating should the filter material become mostly plugged. The vacuum pump used is a vane-type, oilless, 117-volt, 3/4 hp, electrically powered constant flow air vacuum pump from Gast Manufacturing Company.

<u>Filter holder</u>
The current particulate filter assembly consists of a 47-mm particulate filter supported on wire mesh in an aluminum housing that can be disconnected without tools from the air suction tube by a mechanical quick-disconnect fitting.

<u>Silica gel tubes</u>
The water vapor absorber tube consists of a plastic column to hold about 135 g of silica gel mounted in a vertical position, with the air flowing upward through the silica gel. The vertical position prevents the silica gel from settling to one side and provides maximum surface area contact with the air flowing through the tube. The tube can be disconnected from the air suction tube by a mechanical quick-disconnect fitting. The silica gel tubes are installed in a PVC pipe mounted outside the sampler housing to keep the silica gel cooler and increase the vapor collection efficiency.

<u>Flow control</u>
The flow control assembly must regulate the flow of air as the filter becomes loaded with captured particles over the two-week sampling period. The current assembly (SAIC Model LANL 420) consists of flow regulator valves and a pressure-activated timer assembly to record the actual pump run time. This assembly is connected to the sample holders and to the vacuum pump by laboratory-grade tubing of the appropriate size.

Sampling Methods Requirements (B2), continued

Flow meters
The Rotameter-type flow meters (a ball floating on the air rising through the tube) indicate the flow through each branch of the sampling assembly. Meters reading from 0 to 6.0 cfm measure flow through the filters and Matheson brand flow meters reading from 20 to 250 cc/min measure flow through the silica gel. Flow measurements can also be collected using calibrated equipment such as a bubble meter or a magnahelic gauge.

Timer assembly
A vacuum-activated digital timer will be used to record the actual run time of the pump. This device will record the true sampling time to allow calculation of true sampled air volume if a pump does not operate for the full sampling period because of power outages, pump failure, or other causes. Because the timer is battery-powered and is activated by the vacuum created by the proper operation of the pump, it will accurately record the true sampling duration, even for rare problems such as pump failure or connecting-hose breakage.

Electronic dataloggers and notification system
Many AIRNET stations are equipped with electronic dataloggers and either a radio-frequency or cell phone communication system. The datalogger will be programmed to call (via radio or phone) a central computer if the battery voltage drops too low or if the pressure switch on the pump (see paragraph above; this is planned for implementation) closes. The operational status of these stations is checked every working day. This system is intended to assist with meeting the completeness criteria for the system.

ANSI standards for sampling

Samplers meet the intent of the sampling requirements in ANSI N13.1 (1969). See memo ESH-17:97-216 for a description of how each requirement is met.

Meteorology parameters

Atmospheric temperature and relative humidity will be used to calculate tritium concentrations. These parameters will be measured by the Meteorology Monitoring Project according to requirements in the project plan (ESH-17-MET) and procedure (ESH-17-402, “Calibration and Maintenance of Instruments for the Meteorology Monitoring Program”). The measurements have an accuracy of ±1 relative humidity (%) and ±0.2°C temperature.

Sampling Methods Requirements (B2), continued

Sample collection

Sample collection will generally involve traveling to each sampler every two weeks to replace the quick-disconnect particulate filter holder and the silica gel tube with a pre-loaded holder and tube. The flow rates indicated by the flow meters, or by another type of calibrated instrument, and the time shown on the digital timer will be recorded on pre-printed field forms or recorded electronically.

The following procedures give detailed instructions to the samplers for the collection of samples and the documentation of the collection:

- ESH-17-202, "Environmental Sampling of Airborne Particulate Radionuclides"
- ESH-17-204, "Sampling of Airborne Tritium"
- ESH-17-216, "Management of AIRNET Field Data"

Corrective actions on sampling equipment

Operation and maintenance of the field sampling equipment is the responsibility of personnel assigned to perform this work by the Air Monitoring Project Leader. The sample pumps will be checked for proper operation and flow each time the samples are collected. If the pump is defective or if flow rate cannot be brought into specification, the individual collecting the samples will immediately notify the technician responsible for pump maintenance to change the pump. A record of the defect will document the defective pump condition and will be used in future trending [see the section *Assessments and Response Actions (C1)*]. The timer device on the pump will record the actual run time of the pump to allow proper calculation of the air volume sampled.

Equipment such as the filter holders and tubes will be inspected at each use and replaced if found unserviceable. The respective procedure (ESH-17-202 or -204) describes the inspection of the holders and tubes. The silica gel tubes are periodically leak-checked according to ESH-17-234 ("Leak Checking Silica Gel Cartridges").

Preparation and decontamination of sampling equipment

Decontamination of the equipment is generally not required due to the low environmental levels of activity involved, but general cleanliness of the equipment will be maintained. Equipment such as the filter holders will be cleaned at each use, as specified in procedure ESH-17-202.

Pumps will be cleaned at each six-month rebuild. Procedure ESH-17-206 ("Maintenance of Air Sampling Pumps") describes the maintenance, decontamination, and cleaning steps for the air pumps.

Sampling Methods Requirements (B2), continued

Flow control panels in each station will be cleaned and adjusted as necessary according to procedure ESH-17-229 (“Maintenance of AIRNET Flow Control Panels”).

Selection and preparation of sample holders

Procedures ESH-17-202 and -204 describe the preparation of the filters and the silica gel tubes.

Filters holders
The filter holders are a commercially available item. The aluminum three-part holders can be screwed apart, have an O-ring seal at the joints, a wire mesh to support the filter material, and a quick disconnect fitting on the outlet.

Silica gel tubes
The silica gel tubes are a commercially available item (a “refillable gas filter” from Lab Clear, Inc.) made from clear Plexiglas about 5 cm (2 inches) in diameter and 21.5 cm (8 in.) tall. The tube has a screen at each end to hold in the silica gel. The top screws off to allow filling and is sealed with an O-ring. A quick-disconnect fitting allows easy replacement. The quick-disconnect fitting contains a ball that seals the fitting when the connecting part is removed.

Sample volume

Air volume
Though high-volume samplers are recommended by EPA (in Appendix A of “Guidance on Implementing the Radionuclide NESHAPS”), they cannot operate for the two-week sampling period without plugging the filter materials and are too noisy for use near homes or businesses. LANL has therefore chosen to use “medium volume” samplers. Sample volume requirements are based on the optimum flow rate of the pump combined with the collection media. The air sampling pump pulls air through both the paper particulate filter and the silica gel tube.

The particulate filter branch is calibrated to sample 4.0 ±0.4 cubic feet of air per minute (cfm). The total volume of air sampled can be calculated from the timer readings (starting and ending) and the flow rates.

The water vapor sampling branch requires a reasonably constant flow. Historically and currently, a flow rate of 200 ±20 cc/min has been used.

Sampling Methods Requirements (B2), continued

Water vapor
About 135 g of silica gel is used to collect enough water vapor for analysis within the needed detection limits. The amount of water vapor collected will be determined after sample collection (by weighing the cartridges) and at the time of distillation of the water from the silica gel. The minimum water volume needed for analysis is 5 milliliters (to achieve a detection limit of at least 500 pCi/L of water), though a smaller amount can be analyzed using longer count times or with a higher detection limit. Most volumes distilled are between 10 and 20 milliliters, though on occasion, less is recovered due to very low humidity conditions.

Sample preservation methods

No sample preservation steps are required for the filter and silica gel sample media.

Sample holding times

Biweekly samples
Filters: Gamma analysis should be performed on the sample filters as soon as possible after collection (in order to reliably detect short-lived radionuclides such as ^{74}As), but will be performed no later than 72 days after collection. The guide DOE/EH-0173T recommends that the holding time not exceed four half-lives of the shortest-lived radionuclide being monitored (^{74}As with a half-life of 18 days). Gross alpha and gross beta counts of the digested filters will be performed a minimum of 3 days (to allow decay of short-lived naturally-occurring radon daughter isotopes) and a maximum of 90 days after collection.

Silica gel: The water in the silica gel will be recovered by distillation within 21 days of collection. The distillate will be submitted and counted within 14 days of distillation.

Quarterly samples
The composited samples collected during the previous calendar quarter may be held for a maximum of one month (after collection of the last filters for the composite sample) before analysis (to allow sufficient time to meet the requirement to report data within 90 days of the end of the quarter). The analytical laboratory will analyze the samples within 45 days after the field data have been validated and verified.

Sampling Handling and Custody Requirements (B3)

Sample handling and shipment

Particulate filters
Plastic covers will be installed on the filter holders at collection to prevent cross-contamination. Particulate filters will be handled only with tweezers during installation in and removal from the filter holders. After removal, filters will be stored and shipped in glassine envelopes. These steps are specified in procedure ESH-17-202, "Environmental Sampling of Airborne Particulate Radionuclides."

Silica gel
Plugs will be placed over the silica gel tubes after collection to help prevent entry of dirt and absorption of additional moisture. The silica gel will be promptly distilled and analyzed to minimize the chances for contamination. These steps are specified in procedure ESH-17-204, "Sampling of Airborne Tritium."

Sample custody

A documented chain of custody will be maintained for all samples collected from the air sampler stations. The possession, handling, and transfer of custody of samples will be documented. A sample is considered in custody if it is one of the following:

- In one's physical possession.
- In one's view after being in one's physical possession.
- In one's physical possession and then locked up so that no one can tamper with it.
- Kept in a secure area where access is restricted to authorized and accountable personnel only.

A secured area is an area that is locked, such as a room, cooler, vehicle, or refrigerator. If the area cannot be secured by locking, a custody seal will be used to secure the area or the sample container.

ESH-17 sample tracking

A pre-printed form (see Attachment 2 of ESH-17-202) or direct electronic entry (see ESH-17-216) will be used to document the sample collection and the required information regarding location, sampler status, air flow, timer reading, and initial chain of custody. Procedure ESH-17-202 describes to the sampler the steps to follow to collect samples in accordance with appropriate chain-of-custody requirements.

Sampling Handling and Custody Requirements (B3), continued

Sample tracking at laboratories

Samples received by analytical laboratories will be considered physical evidence and handled according to procedures established to meet EPA chain-of-custody requirements. Sample tracking requirements are described in the respective laboratory's quality management plans.

Analytical Methods Requirements (B4)

Sample analyses to be made

Gross alpha, gross beta, and gamma spectroscopy measurements

Gamma-ray spectrometry will be used to determine specific gamma-ray emitting nuclides on groups ("clumps") of biweekly filters from stations with related purposes (e.g., all perimeter stations may be clumped together). Following this, portions of individual particulate filters from each sampling location (typically half filters) will be analyzed for gross radioactivity (alpha and beta). Whole filters may be counted instrumentally (without chemical processing). Alternatively, these samples may be dissolved and the inorganic residue deposited onto counting planchettes for radioactivity measurement by gas flow proportional counting. ESH-17 experience demonstrates that either approach yields comparable data. These prompt analyses are done to provide an early indication of unexpected types or quantities of radioactive materials that may be present from an unplanned release or unusual occurrence and will comply with 40 CFR 61, Appendix B, Method 114 (A-4, B-4, and G-1).

Isotopic analyses

On a quarterly basis, a composite sample of biweekly particulate filters will be prepared. Composites from FFCA stations will be analyzed for specific gamma ray emitting radionuclides using gamma spectroscopy. Then all composites will be analyzed for the presence of selected radionuclides, including ^{238}Pu, $^{239/240}$Pu, ^{234}U, ^{235}U, ^{238}U, and ^{241}Am by dissolving them in an acid solution, chemically separating and concentrating the radionuclides onto sample planchettes, and performing alpha spectrometry. The method will comply with 40 CFR Part 61, Appendix B, Method 114 (A-1).

Tritium analyses

After collection, the biweekly silica gel samples will be heated to distill and collect the water, which will be analyzed for tritium by liquid scintillation counting to comply with 40 CFR Part 61, Appendix B, Method 114 (B-5).

Definition of MDL

The minimum detectable activity level (MDL) has been defined for the AIRNET system at two standard deviations above the average analytical background count rate. The MDLs for each analyte are presented in the subsections below.

Analytical Methods Requirements (B4), continued

Definition of target MDL

The DOE does not specify a minimum detectable activity level (MDL) for any radionuclide. To meet DOE requirements, the project has historically requested MDLs as close to environmental background as practical. Because of differences in the sample quantity, interfering elements, changes in background count rates, natural random variation, and other factors, the MDL will vary from sample to sample. Specifying a maximum MDL will require the laboratory to reach an MDL significantly lower, thus raising costs significantly. Therefore, the project has chosen to specify “target” MDLs to meet DOE requirements.

Conformance to the target MDLs will be determined by averaging the MDLs achieved by the laboratory over any six-month period. Therefore, a target MDL may not always be met, depending on analytical conditions, for a given analytical result.

Gross alpha and beta measurement requirements

Counting of 1) whole filters or 2) the digestate from each half-filter for gross alpha and beta radioactivity will be done on a gas-flow proportional counter capable of counting mixed alpha and beta activity. The minimum detectable alpha and beta activity will be no more than 1 and 2 pCi/filter, respectively, and will comply with 40 CFR Part 61, Appendix B, Method 114 (A-4 and B-4).

Gamma spectroscopy requirements

Measurements of gamma-ray emission by gamma-ray spectroscopy of either individual or clumped filters can provide, simultaneously, both identification and quantitative analysis of gamma-ray emitting radionuclides. These measurements will be conducted using high-resolution germanium detectors coupled with computerized multichannel analyzers and will comply with 40 CFR Part 61, Appendix B, Method 114 (G-1).

For some of the gamma emitting radioisotopes shown in the table below, it is not possible to consistently achieve a detection limit that meets the target MDL equivalent to 0.1 millirems; however, all measurements should meet the MDL equivalent to 0.5 millirems. (as defined in the section *Quality Objectives and Criteria for Measurement Data (A7)*, “Precision,” page 12). The MDL and the target MDL are given in the following table.

Analytical Methods Requirements (B4), continued

To obtain lower detection limits and reduce analytical costs, multiple sample filters may be "clumped" together for counting. By increasing the mass of material to count and counting for a longer time, significantly lower detection limits per cubic meter of sampled air are obtained. If a high count is detected in the "clumped" filters, the filters can be counted individually to determine which contain the radioactive material. Currently, up to 9 filters are combined into one "clump." The "clumping" of filters is described in procedure ESH-17-202 ("Environmental Sampling of Airborne Particulate Radionuclides"). Filters may also be composited for a site over time to improve the detection for a specific location.

Minimum Detectable Activity Levels (MDL) to meet DOE Requirements for Gamma Spectroscopy

Radionuclide	MDL (pCi/m^3) for 0.5 mrem dose	Target MDL(pCi/m^3) for 0.1 mrem dose
^{73}As	0.55	0.11
^{74}As	0.11	0.022
^{7}Be	1.15	0.23
^{109}Cd	0.0295	0.0059
^{57}Co	0.065	0.013
^{60}Co	0.00085	0.00017
^{134}Cs	0.00135	0.00027
^{137}Cs	0.00095	0.00019
^{54}Mn	0.014	0.0028
^{22}Na	0.0013	0.00026
^{210}Pb	0.000028	0.00014
^{83}Rb	0.017	0.0034
^{86}Rb	0.028	0.0056
^{103}Ru	0.13	0.026
^{75}Se	0.0085	0.0017
^{65}Zn	0.00455	0.00091

Specific procedures pertinent to this analytical method are described in the respective analytical laboratory's quality management plans.

Analytical Methods Requirements (B4), continued

Liquid scintillation requirements

After collection of the silica gel tubes, the silica gel will be removed and heated to distill and collect the water; this may be done either at TA-54-1001 or by an external analytical laboratory. Distillate samples will be shipped to an analytical laboratory where the water will be mixed in a scintillation vial with a liquid scintillation cocktail and then counted using liquid scintillation counting to determine tritium concentration. Measurement procedures pertinent to this analytical method will comply with 40 CFR Part 61, Appendix B, Method 114 (B-5). The maximum MDL to meet EPA requirements and the target MDL to satisfy DOE requirements are given in the table below. Note that the target MDL may not always be met, depending on the quantity of water collected and distilled, or if elevated levels of tritium activity exist in a given sample:

Minimum Detectable Activity Levels (MDL) for Tritium Analyses

Radio-nuclide	0.1 mrem dose conc. (Ci/m^3 air)*	Max. MDL for 0.1-mrem dose (pCi/mL distillate)	Target MDL to meet DOE requirements (pCi/mL distillate)
^{3}H	1.5×10^{-11}	6	0.5

* This value obtained from 40 CFR Part 61, Appendix E, Table 2.

Alpha spectroscopy requirements

Composite filter samples for a calendar quarter will be analyzed for ^{234}U, ^{235}U, ^{238}U, ^{238}Pu, $^{239/240}Pu$, and ^{241}Am by digesting one-half of the composited filters in an acid solution, separating, and concentrating (e.g., by electroplating or co-precipitating) the radionuclides onto sample planchettes. The concentrated material will be measured by alpha spectrometry. Alpha spectroscopy methods will comply with 40 CFR Part 61, Appendix B, Method 114 (A-1). For each radionuclide, the maximum MDLs to meet EPA requirements and the target MDLs to satisfy DOE requirements are given in the table below. The target MDLs were chosen based on the MDLs achieved in the past. Radioanalytical procedures pertinent to this analytical method are given in the analytical laboratory’s procedures. Different subcontract laboratories may be utilized in the future for filter analyses.

Analytical Methods Requirements (B4), continued

Minimum Detectable Activity Levels (MDL) for Alpha Spectroscopy

Radionuclide	0.1 mrem dose conc. (Ci/m^3)*	Max. MDL for 0.1-mrem dose (pCi/half filter composite)	Target MDL to meet DOE req's (pCi/half filter composite)
^{234}U	7.7 x 10^{-17}	0.53	0.04
^{235}U	7.1 x 10^{-17}	0.49	0.04
^{238}U	8.3 x 10^{-17}	0.57	0.04
^{238}Pu	2.1 x 10^{-17}	0.14	0.05
$^{239/240}$Pu	2.0 x 10^{-17}	0.14	0.04
^{241}Am	1.9 x 10^{-17}	0.13	0.05

* These values obtained from 40 CFR Part 61, Appendix E, Table 2.

Sample disposition

After analyses, the laboratory will store the planchettes (with the dissolved composite filters) and half filters covered, in a clean area, until notified by ESH-17 that they may be disposed. This notification will be made after the results of the quarterly composites are received and have been accepted. In case of sample loss or analytical problems, it may be necessary to use the dissolved individual filters for a new composite sample.

Quality Control Requirements (B5)

Duplicate sampling and analysis

There are two locations where duplicate samplers are operated in the AIRNET project: Station 39 collocated with Station 26, and Station 38 collocated with Station 27. These duplicate samplers serve as process duplicates to validate the overall sample collection and analysis process and methodology. Data from these duplicate stations will be analyzed by evaluating the measurement differences between stations. Additional information is provided in ESH-17-208 and ESH-17-223.

Trip sample blanks

As part of the regular sample submission every two weeks, two trip blanks are submitted with each filter and tritium sample set. The field sampling procedures (ESH-17-202 and ESH-17-204) describe the preparation, handling, and submission of these blank samples.

Laboratory sample duplicates

The duplicate samples collected at the two stations described above serve as the primary method for laboratory duplicate analyses. ESH-17 may occasionally submit additional duplicate samples, such as:

- previously-analyzed filters (for recounting)
- a split of the silica gel distillate, when sufficient distillate is collected

Analytical laboratories will perform sample duplicate or spike analyses on their equipment in accordance with internal procedures and plans. Contract laboratories generally have policies or procedures that call for analysis of blanks and spikes which are carried through all chemistry steps. For composites, these may consist of a preparation blank and/or a filter blank plus one preparation spike and/or filter spike with every set of 20 samples.

Analytical laboratory instrument checks and calibration

Analytical laboratories must perform appropriate quality control checks on their equipment, so that data generated meets the accuracy and precision requirements given in the section *Quality Objectives and Criteria for Measurement Data (A7)* (“Precision,” page 12 and “Accuracy,” page 13). Each laboratory will be responsible for maintaining appropriate records of checks and supplying quality control information in the data packages, as required by the contract. Each analytical laboratory is responsible for corrective actions for their equipment.

Quality Control Requirements (B5), continued

Required quality control steps of the laboratory analytical processes are described in the subsections to follow.

Gross alpha and beta analyses or radioactivity measurement
Calibration will be performed at least as often as the manufacturer's recommended interval. Background and efficiency data will be maintained. Check sources will be run periodically on the counting instrument to check for proper operation and response.

Gamma spectroscopy analyses
Calibration will be performed at least as often as the manufacturer's recommended interval. Background and efficiency count data will be maintained. Check sources will be run periodically on the instrument to check for proper operation and response.

Distillation of water from silica gel
A single-pan balance will be used to weigh the silica gel. The calibration requirements are given in the section *Instrument Calibration and Frequency (B7)*. No other specialized laboratory equipment requiring checks and calibrations is used in the distillation process. Procedure ESH-17-204 or the appropriate subcontractor laboratory procedure describes the distillation process and specifies cleanliness steps.

Liquid scintillation counting
Calibration and detection limit determinations will be performed at least as often as the manufacturer's recommended interval. Background and efficiency calibration data will be maintained. Check sources will be run periodically on the instrument to check for proper operation and response.

Alpha spectroscopy
Calibration will be performed at least as often as the manufacturer's recommended interval. Background and efficiency data will be maintained. Check sources will be run periodically on the instrument to check for proper operation and response.

Quality Control Requirements (B5), continued

Use of negative values

As a result of the random nature of radioactive decay, negative results can be expected from radioactivity measurement analyses. Negative values will be used in averages and other calculations of air concentrations when the data are known to be acceptable. It is not appropriate to arbitrarily delete negative data from calculations. See discussion on the use of negative numbers in data calculations in the section *Data Review, Validation, and Verification Requirements (D1)*, "Use of negative values," page 50.

Use of data less than MDL

All acceptable data will be used in calculating accuracy, precision, and completeness. See discussion on the use of less-than values in data calculations in the section *Data Review, Validation, and Verification Requirements (D1)*, "Use of data reported as less than MDL," page 50.

Instrumentation and Equipment Testing, Inspection, and Maintenance Requirements (B6)

Preventive maintenance of the air pumps

Operation and maintenance of the field sampling equipment is the responsibility of personnel assigned to perform this work by the Air Monitoring Project Leader. Every six months, the pumps will be replaced with a unit that has received preventive maintenance. This will ensure that the overall reliability of the system is as high as possible.

Pump vanes and certain gaskets, filters, O-rings, and seals will be changed on each pump every six months and the pump will be tested before sampling use. A database will be used to record the serial numbers and track the replacement schedule of all the pumps. Procedure ESH-17-206, "Maintenance of Air Sampling Pumps," specifies the tracking, preventive maintenance, and testing of the pumps.

Preventive maintenance of the flow control panels

Periodic cleaning and adjustment of the flow control panels in each station will be performed according to ESH-17-229, "Maintenance of AIRNET Flow Panels." This maintenance includes cleaning of the control valve and all lines and lubrication of the sealing O-ring.

Operational checks of compliance samplers

During the week between sample collection, compliance samplers (see Appendix A, *AIRNET Sampler Locations*) are checked every working day using the automated notification systems (either radio or phone) to ensure they are still operating properly. These checks will minimize the amount of sample lost in the case of sampler malfunction, power failures, etc.

Instrument Calibration and Frequency (B7)

Calibration of pumps, calibrators, and balances

Pump air flow calibration
Upon installation in the sampler enclosure, the air flow through the pump will be measured with a calibrator (described below) and adjusted, as described in ESH-17-205, “Calibration of Air Sampling Stations.” The calibration procedure will also be performed at least every six months and upon change of any major permanent component of the system; i.e., replacement of the flow regulator assembly or replacement of the tubing during maintenance. Calibration results will be recorded in a logbook.

Calibrator calibration
Three models of air flow calibrators will be used for calibrating the flow through the air sampling pumps: SAIC Radeco Model C-828 Calibrator, Buck Model M-5, and Buck Model M-30 Calibrator. Records will be maintained to document the calibrations. The procedure ESH-17-205 describes the annual recalibration of these instruments by the manufacturers and specifies the records to be kept.

Laboratory balance
A single-pan balance will be used to weigh the silica gel before and after moisture collection. This balance will be calibrated at least annually by the Standards and Calibration Group in accordance with their procedures and the Laboratory “Calibration Handbook” (LALP-93-47). In addition, calibrated check weights will be used to verify proper operation of the balance before each use.

Laboratory instrument calibrations

The laboratory instrument calibration intervals have been set to an appropriate frequency so data generated meets the accuracy and precision requirements given in the section *Quality Objectives and Criteria for Measurement Data (A7)* (“Accuracy,” page 13 and “Precision,” page 12). Each laboratory will be responsible for maintaining appropriate records of calibration and supplying calibration information in the data packages. See the section *Quality Control Requirements (B5)* for details on calibration frequency.

Meteorologic instrument calibration

The instruments for measuring atmospheric relative humidity and temperature will be maintained as specified in the QA project plan for meteorology (ESH-17-MET) and procedure ESH-17-402, “Calibration and Maintenance of Instruments for the Meteorology Monitoring Program.” Currently, these instruments are calibrated annually.

Inspection and Acceptance Requirements for Supplies and Consumables (B8)

Field equipment and supplies

Inspection and maintenance of the field sampling equipment and supplies are the responsibility of personnel assigned to perform this work by the Air Monitoring Project Leader. A visual inspection of most consumables is sufficient to detect problems that may cause loss of data.

Air filters

Filters will be manually cut to the proper size for the filter holders; this process will allow detection of defective filters. Filters are inspected again when installed in the filter holders.

Silica gel

Silica gel will be accepted based on information included in quality certification documents shipped with the materials. Before use, the gel will be dried in an oven to reduce the moisture content (see procedure ESH-17-204). The gel will be inspected visually when loaded in the tubes.

Air sampling pumps

Pumps will receive initial preparation and testing prior to use (run for at least five minutes and tested for a minimum vacuum of 21 in. of mercury), as described in ESH-17-206, “Maintenance of Air Sampling Pumps.”

Laboratory supplies

Inspection and maintenance of laboratory supplies is the responsibility of the individual laboratories. Supplies will be accepted based on information included in quality certification documents shipped with the materials. Subcontract laboratories will appropriately inspect and accept supplies based on the risk to the analytical results.

Data Acquisition Requirements (Non-direct Measurements) (B9)

Non-measurement data sources

The only data acquired from non-measurement sources such as databases, spreadsheets, programs, or literature files are certain dose conversion factors (e.g., in 40 CFR Part 61 Appendix E Table 2, and DOE/EP-0071).

Data Management (B10)

Data transfer and management

Data from the field are entered into a database within two weeks after sample collection and evaluated according to ESH-17-216 (“Management of AIRNET Field Data”). To eliminate data transcription errors, field data are entered directly into small computers and later electronically uploaded to the database (see ESH-17-216, “Management of AIRNET Field Data”).

Most analytical data will be transferred electronically from the analytical laboratories to the ESH-17 databases. Some data will be manually entered into a database. Data will be electronically managed and stored according to procedure ESH-17-033 (“Analytical Chemistry Data Review”). ESH-17 personnel have been assigned responsibility for the establishment and management of the databases and electronic transfer network.

Assessments and Response Actions (C1)

Assessments

See the appropriate project quality plan for a description of the various assessments that are conducted.

Corrective actions

Corrective actions are addressed with the group's deficiency system, described in the QMP, procedure ESH-17-026, and the appropriate project quality plan.

Interlaboratory comparisons

In addition to the regular instrument calibration procedures, each analysis laboratory is required to participate in appropriate interlaboratory comparison programs (such as the program sponsored by the EPA-LV "Performance Evaluation Study" for air filters and for tritium measurements; or the program by DOE-EML that also provides standard air filters, tritium samples, and test gamma spectra). All laboratories must meet acceptable performance standards on each applicable analyte. Failure to meet these standards may result in disqualification of the laboratory until corrective actions have been implemented. Each laboratory must participate in at least one comparison program (as appropriate for the sample types they analyze; these requirements are given in the appropriate scope of work document) to evaluate their performance on the following sample types:

Air filter standards: Each analytical laboratory performing filter counts for the AIRNET must analyze filter evaluation samples at least annually. ESH-17 will consider the laboratory's results to be satisfactory if they meet the system's acceptance criteria. A report must be sent to ESH-17 to document the results of the evaluations.

Tritium standards: Each analytical laboratory performing tritium analyses for the AIRNET must analyze tritium evaluation samples at least annually. ESH-17 will consider the laboratory's results to be satisfactory if they meet the system's acceptance criteria. A report must be sent to ESH-17 to document the results of the evaluations.

Gamma equipment comparison: A test gamma spectrum, supplied as files on floppy disks to check the proper determination of gamma emitting elements, will be run through the gamma software. The DOE-EML interlaboratory comparison program supplies file spectra. Each analytical laboratory performing gamma analyses for the AIRNET should attempt to participate in this program, or an equivalent, at least annually.

Assessments and Response Actions (C1), continued

AIRNET action levels

After the data evaluation process [see the section *Validation and Verification Methods (D2)*, page 51], all data from the AIRNET samples will be reviewed for high values according to procedure ESH-17-201, "Evaluating AIRNET Data Against Action Levels." This procedure describes how the action levels are developed and the actions to be taken to verify the high reading, notify appropriate personnel and managers, and document the actions. The procedure describes the two different action levels (*investigation* and *alert*) for different groups of stations.

Emergency response actions

ESH-17 may be asked by the Laboratory Emergency Management Office to respond to a suspected release of radioactive materials. In such cases, air filters will be collected as soon as possible and analyzed on a priority basis. Analytical chemistry requirements for these air filters are presented in ESH-17-230, "AIRNET Sample Analyses for Unplanned Releases." Results will be forwarded to the responsible Laboratory management for appropriate use in decision making. Dose may be calculated if necessary as described in ESH-17-503, "Calculation of Doses from Unplanned Releases."

Reports to Management (C2)

Reports

Data reports will be prepared and distributed as specified in the respective project quality plans.

Data Review, Validation, and Verification Requirements (D1)

Criteria used to accept, reject, or qualify data

All data will be evaluated for one of three outcomes: accept, qualify, or reject. Data evaluation criteria will include:

- within expected range of values
- proper laboratory methods
- acceptable analytical uncertainty

The limits for acceptability and the methods used are explained in the next two sections [*Validation and Verification Methods (D2)* and *Reconciliation with Data Quality Objectives (D3)*].

Data types to be evaluated

Data are evaluated according to procedures ESH-17-033 (“Analytical Chemistry Data Review”), ESH-17-208 (“Evaluation of Biweekly AIRNET Data”), ESH-17-216 (“Management of AIRNET Field Data”), and ESH-17-223 (“Evaluation of Quarterly AIRNET Data”). Many of the checks described in this section are performed electronically utilizing database queries.

The data needed for determining air concentrations can be categorized into three areas: field, analytical chemistry, and meteorological data. Each data category is made up of various data elements, as listed below.

Field data:

- collection date and time
- sampler number
- timer reading
- filter flow rate at installation
- filter flow rate at removal
- silica gel flow rate at installation

Data Review, Validation, and Verification Requirements (D1), continued

- silica gel flow rate at removal
- silica gel mass at installation
- silica gel mass at removal
- moisture distillation volume
- comments

Radiochemistry data:
Analytical chemistry data packages are generated by the subcontractor laboratories. Data packages will be reviewed within 3 weeks for conformance to contract specifications and for data usability according to procedure ESH-17-033 ("Analytical Chemistry Data Review"), which includes:

- presence of narrative letter
- presence of summary data table
- properly completed chain-of-custody forms
- analytical completeness
- proper holding times and analytical time sequences
- required detection limits on analytical methods
- expected blank sample values
- evidence of cross-contamination
- numbers that appear inconsistent
- complete calibration documentation
- traceability of standards

The radiochemical analytical data to be extracted from the packages are:

- analyte
- date of analysis
- result
- uncertainty
- units
- MDA

Missing analytical data will be reconstructed or estimated based on a professional evaluation of the reasons for the missing or incomplete data. In some cases, an appropriate estimated value may be used. Such data will be flagged as "qualified."

Data Review, Validation, and Verification Requirements (D1), continued

Meteorological data:
The meteorological data (relative humidity and temperature) will be used to calculate 15-minute absolute humidity concentrations. These 15-minute concentrations are averaged from Tuesday midnight at the beginning of the sampling period through Tuesday midnight at the end of the sampling period. Absolute humidity will be determined as the average of all tower locations not used for site-specific monitoring. These averaging periods were evaluated in memo ESH-17:98-283.

Air concentration data:
Air concentration records are generated for each radionuclide at each sampler using field, count, and analytical laboratory data. Air concentration records will also be reviewed for acceptance, rejection, or qualification. The air concentration record will be evaluated within thirty days of the completion of the field data record and radiochemistry record. The data used to calculate air concentration values consist of:

- air volume through filter during sample period
- sum of air volumes for quarterly composited filters
- average absolute humidity during the sampling period
- radiochemical analyses
- analyte concentration in the sample
- analyte concentration uncertainty in the sample
- analyte concentration units for the sample

Handling of outliers

During the data evaluation process, steps may be taken to identify and test for individual concentration values that would be considered outliers by applying various statistical techniques.. In some cases, it is not appropriate to include known outliers in the calculation of the summary statistics for a sampler. Professional judgment will be exercised in these decisions (ESH-17-208, “Evaluation of Biweekly AIRNET Data,” and ESH-17-223, “Evaluation of Quarterly AIRNET Data”).

Data Review, Validation, and Verification Requirements (D1), continued

Calculation of summary statistics

Summary statistics for each sampler will be calculated. The elements of the summary record consist of:

- annual mean radionuclide concentration at each station
- standard deviation of the annual concentration calculated from the individual measurements at each station
- uncertainty of analytical results or comparisons to the MDAs or MDLs.

The environmental variability is characterized by the sample standard deviation of either the biweekly or quarterly analyte. The variation due to the radio-analytical process is included in the sample standard deviation.

Use of negative values

Environmental data with negative or "less than" values will be used in calculations in order to obtain the best estimate of the true value (DOE/EH-0173T). The true value, which is always unknown for a continuous variable, cannot be negative but is estimated by the average of many measurements, some of which may be negative (especially when the true value is very close to zero). Thus, arbitrarily discarding negative values will improperly bias the estimate of the true value. For a full explanation of this statistical principle, see memo ESH-17:95-384.

Use of data reported as less than MDL

When data are reported as being "below minimum detectable activity level" (when an actual value is not presented), the concentration will not be assumed to be zero, but can be calculated using a methodology suggested in "Guidance for Data Quality Assessment" (EPA QA/G-9, pages 4-54 to 4-61). The method depends on the percentage of results reported as "non-detects."

Use of data reported with value less than MDL

Radio-analytical values will be reported even if the result is below the published laboratory minimum detectable activity level (MDL), since the background count is usually some positive value. Reported values of less than the detection limit require professional evaluation to interpret. Statistically, these results have a low level of confidence associated with them (50% or less), and actions and decisions based on such data may not be warranted.

Validation and Verification Methods (D2)

Evaluation of field data

The group continues to automate most of the checks described in this section in a computer database program.

Each of the field data types listed in the previous section will be evaluated as described in ESH-17-208 (“Evaluation of Biweekly AIRNET Data”), ESH-17-216 (“Management of AIRNET Field Data”), and ESH-17-223 (“Evaluation of Quarterly AIRNET Data”) for completeness and expected range of values:

1) Completeness
Each field element should have a value. If a value is missing, an explanation should be provided. If a datum is missing without an acceptable explanation, the record will be considered “qualified.” The following table lists the more frequent explanations for missing data points.

Common Explanations for Incomplete Data Points

Field Element	Explanation
Timer reading	Power out
Timer reading	Timer or vacuum switch malfunction
Timer reading	Timer not reset
Filter flow rate	Flow meter broken/malfunction
Gel mass	Sample lost in distillation

2) Expected range of values
Each element has a nominal value with a range of possible values. If the element is outside its range of normal values, the record will be identified as “qualified.” The nominal and normal range of values for data elements are given in the procedure ESH-17-216, “Management of AIRNET Field Data.”

If the field record is not “qualified” or “rejected,” it will be accepted. If the field record is “qualified,” further validation and verification will be performed. Best professional judgment will be applied to “qualified” data. Amended field records will be considered acceptable but will be flagged as “qualified.”

Validation and Verification Methods (D2), continued

Evaluation of analytical data

The analytical data (gross alpha, gross beta, and gamma spectroscopy) packages will be evaluated by the ESH-17 analytical chemist according to procedure ESH-17-033, "Analytical Chemistry Data Review," to verify that the count data package is acceptable according the criteria given in the previous section [*Data Review, Validation, and Verification Requirements (D1)*]. After this review, the data will be evaluated as described in ESH-17-208 ("Evaluation of Biweekly AIRNET Data") and ESH-17-223 ("Evaluation of Quarterly AIRNET Data") for completeness and expected range of values:

1) Completeness
If a value is missing, the record will be rejected. An explanation must be provided.

2) Expected range of values
The analytical data must be within an expected range of possible values. If the value is outside its range of normal values, the record will be identified as "qualified" and possibly investigated according to ESH-17-201 ("Evaluating AIRNET Data Against Action Levels").

If the analytical data are not "qualified," they will be accepted. If the data are "qualified," further validation and verification will be performed. Amended field records will be considered acceptable but will be flagged as "qualified." No datum will be rejected unless it can be clearly shown that it is incorrect or non-representative.

Calculation of air concentrations

Air concentrations are calculated (ESH-17-223, "Evaluation of Quarterly AIRNET Data") with the following data:

- total sampler run time for sample period
- sampler air flow rate during sample period
- reported total concentration of the radionuclide on the filter or in the water vapor sample
- for tritium concentrations, absolute humidity calculated from humidity and temperature measurements

The nominal and normal ranges of values for air volume per sample period are given in the procedures ESH-17-216 ("Management of AIRNET Field Data") and ESH-17-223 ("Evaluation of Quarterly AIRNET Data"). If the respective volume is out of range, it will be flagged as "qualified."

Validation and Verification Methods (D2), continued

If any source datum used to calculate an air concentration value is "qualified," then the air concentration value is considered "qualified." Air concentration values that do not have a "qualified" status are considered accepted values, having satisfied all the data review, validation, and verification requirements.

Professional evaluation of qualified data

A professional evaluation (ESH-17-208 and ESH-17-223) will be performed to estimate or otherwise complete data labeled as "qualified." After this evaluation, the data will be either rejected or accepted for use in calculating the air concentration values. If the value remains qualified, it will be used in concentration calculations.

Gross beta air concentration can be used as an indicator of appropriate sampler operation. If the gross beta air concentration is outside the nominal range, the air concentration record should undergo further validation and verification analysis; e.g., identification of the radioisotope(s) contributing to a higher-than-normal beta reading or determination of the reasons for improper sampler operation. Unless good evidence exists to justify rejection, the datum will be accepted as "qualified." This will ensure a conservative approach to potential emissions; that is, there must be adequate evidence to reject a potential "false positive" result. All rejected data will be maintained in the database with the explanation for their rejection.

Verification by hand calculation

The data calculations performed by the database or spreadsheet program will be verified periodically by manually calculating annual average air radionuclide concentrations from at least one raw data set, as described in ESH-17-208, "Evaluation of Biweekly AIRNET Data." These calculations will be compared to the database results to verify proper database operation.

Validation and Verification Methods (D2), continued

Calculation of dose from air concentration values

See the respective quality project plan for project-specific requirements for calculation of doses and reporting of data. To demonstrate compliance with the 10-mrem EPA standard, doses are calculated from AIRNET mean concentration data using 40 CFR Part 61, Appendix E, Table 2. The doses for the FFCA compliance stations (see Appendix A, *AIRNET Sampler Locations*) are used, in conjunction with other data, to demonstrate compliance with the 10 mrem EPA standard. Doses from all AIRNET stations are also evaluated for use in calculating the dose to the public from all pathways. The dose from all pathways is compared to the DOE public dose limit of 100 mrem.

In the case of an unplanned release or an emergency response, dose can be calculated as described in ESH-17-503, “Calculation of Doses from Unplanned Releases.”

Comparison to action levels

The air concentrations will be reviewed to determine if any exceed the investigation or alert action levels, as described in the section *Assessments and Response Actions (C1)*, “AIRNET action levels,” page 46. Procedure ESH-17-201 (“Evaluating AIRNET Data Against Action Levels”) describes the process and the actions to be taken.

Reconciliation with Data Quality Objectives (D3)

Calculating data precision

Periodically, the precision of the analytical results will be evaluated by a method similar to that used in the estimation of overall uncertainty presented in the DQOs of the appropriate project quality plan (see memo ESH-17:95-759). The precision will be compared to the required overall precision of 20% at the levels in 40 CFR Part 61, Appendix E, Table 2 (equivalent to an annual dose of 10 mrem).

Calculating data completeness

For all stations, data completeness will be calculated on at least an annual basis for each sampling location (compliance stations will be calculated more frequently). Completeness will be calculated as follows:

- Run time of each station: the total operating hours of each sampler (from the timer readings) divided by the hours in the time period being evaluated.
- Sample completeness: number of verified and validated sample results obtained at a sampler divided by the total number of possible samples (adjusting for stations that were established for only part of the year) in a calendar year.

These data will be compared to the completeness criteria specified in the DQOs of the appropriate quality project plan (90% or 95% run time and 80% for sample completeness).

Failure to meet specified DQOs

When differences are identified between specified (see the DQOs in the appropriate quality project plans) and measured values for precision and completeness, a deficiency report will be generated (ESH-17-026), and the causes of the differences will be investigated, reported to management, and corrected where possible.

Click here to record “self-study” training to this procedure.

APPENDIX A

AIRNET Sampler Locations

The following samplers are in place on the date of this plan. For a current list, contact the Rad-NESHAP, Air Monitoring, Area G project leader, or the ESH-17 records coordinator.

Key to groups: R = regional and pueblo stations
P = perimeter stations (includes compliance stations)
O = onsite stations and Environmental Restoration program stations
W = waste storage stations
Q = quality assurance stations

*-- Indicates 17 compliance stations. †-- Indicates 3 background (regional) stations. ‡ Indicates 6 stations to be operated to same standards as compliance stations.

Station number	Group	Station Name	Location
1†	R	Española	On the Northern New Mexico Community College campus on the west side of Española next to the Chama highway, east of the two-story science building.
3†	R	Santa Fe	In Santa Fe off Siringo Road, near the city park and elementary school, next to a building owned by GSA, behind the school.
4	P	Barranca School	At Barranca School on Barranca Road, on the south side of the school.
5	P	Urban Park	Off North Road near the south end of Urban Park, near the water tanks.
6*	P	48th Street	Off 48th Street off Sandia, inside the fences of the water tanks.
7*	P	Los Alamos Shell Station	Behind the Shell station on the corner of Oppenheimer and Trinity Drive, behind and to the right of the station.
8*	P	McDonald’s Restaurant	South of the McDonald’s on Trinity Drive, south of storage buildings, over the south rim.
9*	P	Los Alamos Airport	Near the airport terminal building, west of the old incinerator building northwest of the terminal building.
10*	P	East Gate	At the abandoned guard tower next to Highway 502 east of the airport.
11*	P	Well PM-1	West of the intersection of SR 4 with East Jemez Road, west and outside of the service building for Well PM-1.
12*	P	Royal Crest Trailer Court	To the south of the Royal Crest trailer court off East Jemez Road, enclosed by a chain-link fence.
13*	P	Rocket Park	In White Rock, east of Tennis Courts north of Piñon School, south of “Rocket Park” off Sherwood Drive.
14*	P	Pajarito Acres	In White Rock near corner of Piedra Drive and Monte Rey North.

Station number	Group	Station Name	Location
15*	P	White Rock Fire Station	In White Rock on Rover Blvd., at the firehouse, in the vacant area on the side of the building.
16*	P	White Rock Nazarene Ch.	In White Rock at the intersection of Pajarito Road and SR 4, by the back of the building.
17	P	Bandelier Fire Lookout	In Bandelier National Monument, at the fire tower lookout about 1 mile past entrance.
20*	O	TA-21/ Area B	At TA-21, at end of DP Road, to east of paved parking area before guard gate, west of the lot by the fence.
23	O	TA-5 Beta Area	At TA-5, the transformer station located on the east side of the road, on the east side of the fence east of TA-52.
25	O	TA-16-450	Inside TA-16 (near back gate), along the fence just east of building TA-16-450, the tritium facility.
26	P	TA-49	At the entrance to TA-49 along SR 4 near Bandelier National Monument, at the entrance to TA-49.
27‡	W	TA-54/ Area G	In TA-54, about halfway down the site along the north fence.
30‡	O	Booster P-2	Along Pajarito Road at the turn off to TA-54, inside the fence for the large water tank and pump house.
31	O	TA-3	In the main technical area to the west of Diamond Drive, against the fence.
32*	P	County Landfill	On East Jemez Road at the County Disposal site, to the right of the entrance.
34‡	W	Area G-1/ NE corner	In TA-54, in the far northeastern corner of the area, outside the perimeter fence of Area G.
35	W	Area G-2/ back fence	In TA-54, halfway down the site along the southern fence.
36‡	W	Area G-3/ office	In TA-54, east of the main office building for TA-54.
38	Q	Area G/ QA	Next to station #27.
39	Q	TA-49/ QA	Next to station #26.
41	R	Sn. Ildefonso Pueblo	In San Ildefonso Pueblo, near the pueblo fire station.
45	W	Area G - SE perimeter	In TA-54, in outer perimeter area southeast of the fence.
47	W	Area G - N perimeter	In TA-54, in outer perimeter area north of the fence.
49	O	Pajarito Rd. (TA-36)	On Pajarito Road to the east of TA-18, at the old sludge pond site (TA-36).
50	W	Area G - expansion	In TA-54, near power pole 2939 northwest of the preparation facility.

Station number	Group	Station Name	Location
51	W	Area G - expansion pit	In TA-54, along the north fence of new pit near power pole 2942.
54‡	P	TA-33 East	East side of TA-33, near SE corner of Laboratory property, near edge of White Rock Canyon and radiotelescope.
55‡	R	Santa Fe West	Northwest of Santa Fe, along Camino la Tierra at Booster Station #4.
56†	R	El Rancho	North of State Highway 502 between Pojoaque and the Rio Grande.
59	R	Jemez Pueblo	At Jemez Pueblo on SR 4, west of Jemez Springs (35 mi. of Los Alamos), at visitor center.
60*	P	Los Alamos Canyon	In Los Alamos (“Omega”) Canyon, along the road east of the Ice Rink.
61*	P	LA Hospital	Near the intersection of Trinity Drive and Diamond Drive, east of the LA Medical Center building.
62*	P	Crossroads Bible Church	East of the Los Alamos Crossroads Bible Church building.
63*	P	Monte Rey S	In White Rock, near the intersection of SR 4 and Monte Rey South.
71	O	TA-21-01	Along the right side of the TA-21 perimeter fence.
76	O	TA-15-NNW (Ammo site)	In TA-15 on the road leading to IJ site, next to small ammo building.
77	O	TA-36 (IJ site)	In TA-36 inside IJ firing site area.
78	O	TA-15-N	In TA-15 at vacant building 12-40.
90	P	East Gate backup	Backup station for East Gate (#10).

*-- Indicates 17 compliance stations. †-- Indicates 3 background (regional) stations. ‡ Indicates 6 stations to be operated to same standards as compliance stations.

APPENDIX B

References

<u>Requirements and guidance documents:</u>

Title 40 Code of Federal Regulations Part 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities," December 15, 1989

Title 40 Code of Federal Regulations Part 58, "Ambient Air Quality Surveillance," Appendix E

DOE Order 5400.1, "General Environmental Protection Program," changed June 29, 1980

DOE Order 5400.5, "Radiation Protection of the Public and the Environment," changed January 7, 1993

DOE Order 5480.11, "Radiation Protection for Occupational Workers," changed June 17, 1992

DOE Order 5700.6C, "Quality Assurance," issued August 21, 1991

DOE/EH-0173T, "Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance," January 1991

DOE/EP-0071, "Internal Dose Conversion Factors for Calculating Dose to the Public", July 1998

DOE/HQ DRAFT document, "DOE Records Schedule for Environmental Records," November 1996

PRD-110-01.0, "LANL Quality Assurance Management Plan," Los Alamos National Laboratory, January 1, 1993

LALP-93-47, "Calibration Handbook," Los Alamos National Laboratory, June 1993

EPA QA/R-5, "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations," Interim Final, January 1994

EPA QA/G-4, "Guidance for the Data Quality Objectives Process," final, September 1994

EPA QA/G-9, "Guidance for Data Quality Assessment," External Working Draft, March 27, 1995

EPA "Guidance on Implementing the Radionuclide NESHAPS," July 1991

FFCA, “Appendix A Compliance Plan” of the “Federal Facility Compliance Agreement, June 1996

ANSI N13.1-1969, “Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities”

Consent Decree, Concerned Citizens for Nuclear Safety vs. U.S. Department of Energy and Sigfried S. Hecker, U.S. District Court for the District of New Mexico, 1/17/97

Group ESH-17 Air Quality documents:

ESH-17-QMP, “Quality Management Plan for the Air Quality Group”

ESH-17-MET, “Quality Assurance Project Plan for the Meteorology Monitoring Project”

ESH-17-RN, “Quality Assurance Project Plan for the Rad-NESHAP Compliance Project”

ESH-17-022, “Preparation, Review, and Approval of Procedures”

ESH-17-024, “Personnel Training”

ESH-17-025, “Records Management”

ESH-17-026, “Deficiency Reporting and Correcting”

ESH-17-029, “Management Assessments”

ESH-17-030, “Document Distribution”

ESH-17-032, “Orienting New Employees”

ESH-17-033, “Analytical Chemistry Data Review”

ESH-17-201, “Evaluating AIRNET Data Against Action Levels”

ESH-17-202, “Environmental Sampling of Airborne Particulate Radionuclides”

ESH-17-204, “Sampling of Airborne Tritium”

ESH-17-205, “Calibration of Air Sampling Stations”

ESH-17-206, “Maintenance of Air Sampling Pumps”

ESH-17-207, “Evaluation of AIRNET Sampler Sites against Siting Criteria”

ESH-17-208, “Evaluation of Biweekly AIRNET Data”

ESH-17-216, “Management of AIRNET Field Data”

ESH-17-223, “Evaluation of Quarterly AIRNET Data”

ESH-17-229, “Maintenance of AIRNET Flow Panels”

ESH-17-230, “AIRNET Sample Analyses for Unplanned Releases”

ESH-17-234, “Leak Checking Silica Gel Cartridges”

ESH-17-402, “Calibration and Maintenance of Instruments for the Meteorology Monitoring Program”

ESH-17-501, “Dose Assessment Using CAP88”

ESH-17-503, “Calculation of Doses from Unplanned Releases”

ESH-17-506, “Calculation of Air Activation Activity from TA-18”

Memo ESH-17:95-384, “Statistical Analysis of Environmental Data With Negative Values,” Craig Eberhart to Distribution, May 19, 1995

Memo ESH-17:95-759, “AIRNET Uncertainty Calculations,” Keith Jacobson to file, December 20, 1995

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Memo ESH-17:97-561, “Update on Gamma Measurement Decisions,” Craig Eberhart to Distribution, December 12, 1997

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Memo ESH-17:00-133, "AIRNET Sampling at Ski-Hill", from Keith Jacobson to Rad-NESHAP project records, February 18, 2000

Other references:

ICRP, "Limits for Intakes of Radionuclides by Workers," International Commission on Radiological Protection, ICRP Publication 30, Annals of the ICRP; Vol. 3, No. 11-4 (1979); Vol. 5, No. 1-6 (1981); Vol. 7, No.1-3 (1982); and Vol. 8, No. 1-3 (1982)